

## Design and Development of AC DC Electrical Installation and Maintenance (EIM) Trainer

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**Abstract.** This research project aimed to developed an AC DC EIM Trainer, an innovative technology that address the needs of learners for better learning in Electrical Installation and Maintenance. If this trainer will be utilized, it will particularly benefit the learners and teachers. The developmental research design will be utilized in this study; particularly the product-development wherein the developed product is analysis, design, development implementation and evaluation. The trainer is portable so the learners and teachers can transfer it from one place to another and equipped of handle and rubber edge protector. Likewise, the trainer is also having feature that can use either AC or DC source. The developed device has the following technical characteristics like Design, Materials used, Functionality, Safety provision, Performance Efficiency, Compatibility, Usability, Reliability, Maintainability, and Portability. The researcher believes that learners will be interested in using this Instructional Trainer. The ease and practicality of using the trainer may enable the students to focus more in their studies. As a result, their performance in the class will improve and they will become more competent and skilled learners in the field of Electrical Installation and Maintenance.

*Keywords:* instructional trainer, academic experts, portable, ac dc source, skilled learners

## 1. Introduction

Instructional materials which are adequate and sufficient are needed for the students to acquire the necessary competencies in any subject. These are the things that enable students to have mental picture of what has been taught and to retain the message in their memory for a very long time. It is believed that instructional materials assist teachers in making their lessons easy to be understood by learners, Kaku, D. W. & Arthur, F., (2020),

Traditional teaching using a textbook, oral lectures and a single written examination can be enhanced with multiple new methods for teaching. Not only replacing part of the oral lectures with practical assignments, but also new teaching methods for practicing the theoretical content, can be implemented. The aim of the hardware trainer, is to directly show the students, the relation between theory and practice. The hardware should be configurable, to be able to use it for various applications, ranging from dc-dc converters for solar and battery interfacing, inverters for motor control and synchronous buck converter for DC grid manager. The hardware trainer is to be extended with a dedicated control and load board. Peter J. van Duijsen & Diëgo C. Zuidervliet, (2022)

The researcher used the old black board as medium for installing the electrical materials. He tried to re-use indigenous materials available in school and other materials were usually bought. The use of "realia method" is the best strategy in teaching TVL students because it is relevant to classroom teaching the realities of life and it get the attention of the students while teaching.

According to Zacharias C. Zacharia & Ton de Jong (2014) Instructional design (ID), also known as instructional systems design (ISD), is the practice of systematically designing, developing and delivering instructional materials and experiences, both digital and physical, in a consistent and reliable fashion toward an efficient, effective, appealing, engaging and inspiring acquisition of knowledge. The process consists broadly of determining the state and needs of the learner, defining the end goal of instruction, and creating some "intervention" to assist in the transition. The outcome of this instruction may be directly observable and scientifically measured or completely hidden and assumed.

The researcher dreamed and proposed this AC DC EIM Trainer in teaching Electrical Installation and Maintenance; for the availability, usability and

portability every time the teachers give a performance task for their learners. The purpose of the Instructional Trainer is to bring in all the needed electrical materials in one performance task, that would actually develop the competencies needed in Electrical Installation and Maintenance National Certificate Level II (NC II) like, Terminating and Connecting Electrical Wiring and Electronic Circuits, TR – EIM NC II (2015).

These competencies are needed for assessment and gaining a National Certificate Level II (NC II) and the learner who has achieved this Qualification is competent to be: Building–Wiring Electrician, Residential/Commercial–Wiring Electrician and Maintenance Electrician. That is why the thing running on the researcher’s mind is that every learner that will use the Instructional Trainer will gain the skills and competence on assessment and will be called competent Electrician. The researcher’s dream came true with the help of the Instructional Trainer.

These AC DC EIM Trainer might let the students more interactive, participative and enjoyable in the class that lead to improve students’ performance. When teacher and students use locally–made instructional materials, they themselves will be benefited by acquiring new skills and becoming globally competitive individuals. In the study of Robledo, D.A. R. and Roleda, L. S., (2019), about the use of improvised instructional materials in teaching, they found that it strengthened their understanding through experiencing the use of the materials.

## 2. Methodology

The researcher used developmental research which is defined as the systematic study of designing, developing, and evaluating instructional program, process and product that must meet criteria of internal consistency and effectiveness. Developmental research is particularly important in the field of instructional technology. In this research, ADDIE model is used in the design and development of AC DC EIM Trainer.

The development of instructional trainer pertains to analysis, design, development, implementation and evaluation. Meanwhile, the trainer will be validated by the Academic Experts in technical characteristics terms of Design, Materials used, Functionality, Safety provision, Performance Efficiency, Compatibility, Usability, Reliability, Maintainability, Portability, and Implications of the trainer.

### 3. Results and Discussion

#### *3.1. Designing and developing the AC DC EIM Trainer*

The designing and developing phase of the AC DC EIM Trainer followed the stages of the ADDIE model, However, the researchers excluded the last two stages such as the implementation and evaluation to suit the needs of the study which is design and develop.

##### *3.1.1. Analysis Phase*

Under the analysis phase, the researcher studies the problems or issues that occurred during the performance task and skills demonstrations of the learners. The researcher gathered needed data to create and formulate concepts for the AC DC EIM Trainer. The researcher analyzed the syllabi of instruction in Electrical Installation and Maintenance and the existing instructional materials and devices. The results were the bases in the next stage of development so that the device being developed could meet the students' needs.

The analysis phase of the study, the researchers focused on examining the features of existing EIM Trainer used in the industry and academic institutions that offer traditional EIM performances. Through careful observation, the researchers identified several common characteristics of these EIM Trainer.

Firstly, the physical structure of the traditional EIM Trainer was found big, resulting in their large and heavy nature. This bulkiness made them inconvenient to move in other places.

**Table 1 Bills of Materials of the AC DC EIM Trainer**

Quantity	Unit	Materials	Price
2	pcs	FiberGlass 16 ¾ x 12 1/2 x1/8	₱1,000.00
2	pcs	Bulb 220v	₱120.00
3	pcs	Bulbs 12v	₱540.00
5	pcs	Receptacle	₱125.00
53	pcs	Banana Plug (red/back)	₱300.00
24	pcs	Banana Connector	₱320.00
1	pc	Convenience Outlet 3 Gang	₱150.00
1	pc	Convenience Outlet 2 Gang	₱120.00
1	pc	Convenience Outlet Single	₱100.00
1	pc	Air Condition Unit Outlet	₱120.00
1	pc	Flush Type Switch 3 Gang	₱180.00
1	pc	Flush Type Switch 2 Gang	₱150.00
2	pcs	Single Pole Switch	₱240.00
2	pcs	Three Way Switch	₱300.00
1	pc	Four Way Switch	₱600.00
1	pc	see saw switch w/ light indicator 12v	₱35.00
1	pc	see saw switch w/ light indicator 220v	₱50.00
1	pc	Flush Type Circuit Breaker 20ampere	₱450.00
1	pc	Power Supply12v	₱440.00
10	Meters	Electronics Wire#18	₱200.00

1	Pc	Inverter 500w	₱900.00
1	pc	Battery 12v 8Ah	₱495.00
<b>Total</b>			<b>₱6,935.00</b>

As shown in the table, the bill of materials of the EIM instructional trainer amounted ₱ 6,935.00 only and was developed within ten (10) working days and it shows that the trainer is cheaper compared to the old big marine flyboard electrical wiring installation trainer. It indicates that the instructional trainer is very economical. If given the chance in the market, it would be a great help for further skills development of learners in their respective schools. , the aim was to create an inclusive and accessible IPAB design that caters to the needs of all users.

### 3.1.2. Design Phase

After analyzing the need, the researcher proceeded designing the instructional trainer. In this phase, the researcher considered what would the output look like, as well as what would be its features. To make the design convenient, the researcher added features to the trainer, such as; safety and portability.

Several diagrams were constructed to visualize the designs and conceptual frameworks of the AC DC EIM Trainer. The researcher made a trainer that could suit the needs of the students. The design was constructed by using AC DC EIM Trainer parts like frame housing, fiber panel board, 5 receptacles, 2 AC bulbs, 3 DC bulbs, banana plug, banana connector, 3 gang convenience outlet, 2 gang convenience outlet, single convenience outlet, air condition unit outlet , 3 gang flush type switch, 2 gang flush type switch, single pole switch, 2 three-way switch, 1 four-way switch, flush type circuit breaker 20A, power supply 12 volts, see saw switch with light 220 volts, see saw switch with light 12 volts, Electronics Wires # 18, Inverter Bosca and Battery 12v.

All electrical parts were mounted and labeled on a fiber panel board and then mounted in a wooden enclosure and supported by banana plugs which were soldered to the AC DC EIM Trainer components to serve as the terminals in

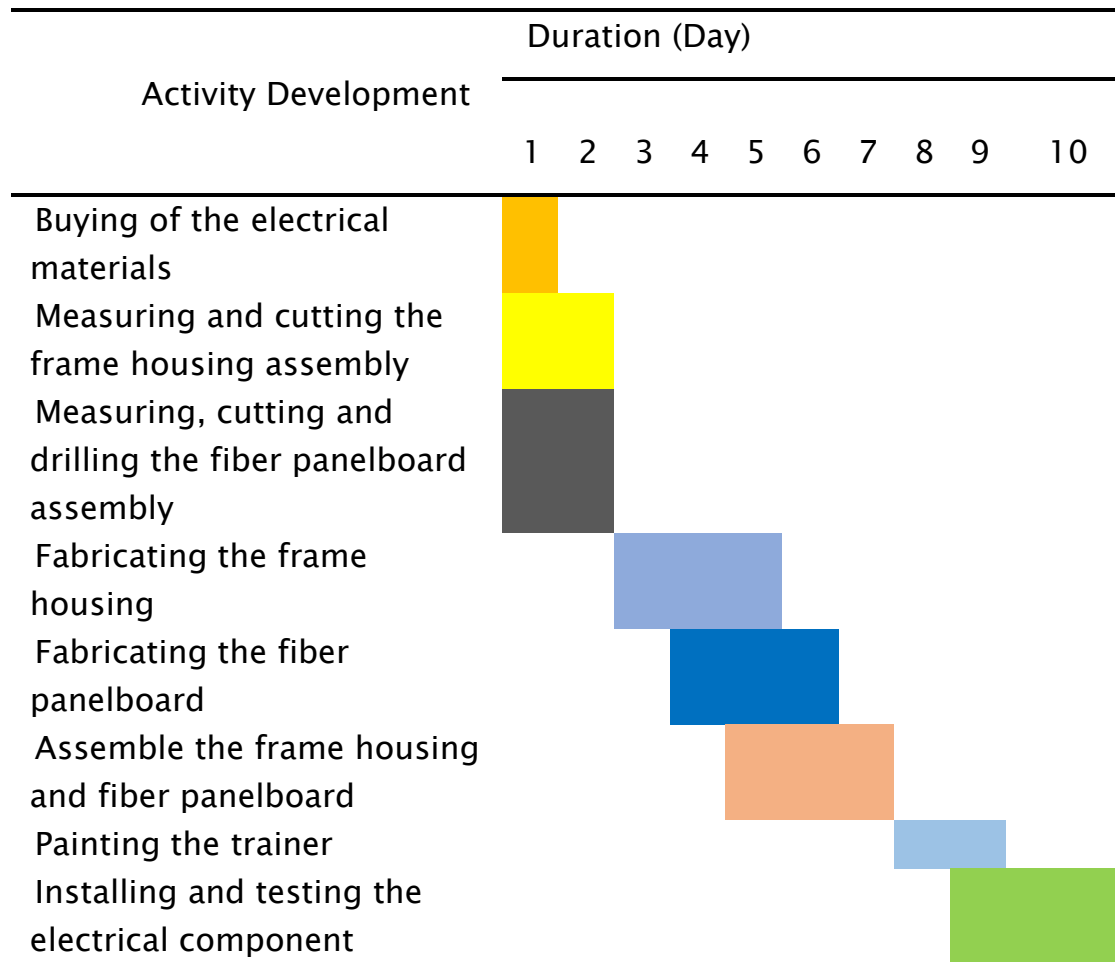
electrical installation. The design was made easy in terms of installation by plugging in and plugging out the banana plug connectors based on the activities that had to be given to students during their performance task.

**3.1.3. *Development Phase***

In this phase the researcher trying to work the idea of developing an innovation to address identified problems in the field of TVL–Industrial Arts–EIM.

On the development phase, the researcher developed the instructional trainer, following the procedures, such as; actualize of its design, purchase and preparation of electrical materials, measuring, cutting, bringing together and assemble the electrical and electronics circuit of the AC DC EIM Trainer.

**Table 2 Gantt Chart of AC DC EIM Trainer Development**



The Gantt chart serves as the guide of the researcher when started constructing the AC DC EIM Trainer. Buying of available materials was done on the first day. These materials are mostly the electrical materials. For the researcher to construct his trainer while still performing his duties and responsibilities as a SHS teacher and lecturer on hourly basis, he utilized his free time in conducting it.



Figure 1 Showing the Development of AC DC EIM Trainer



Throughout the development phase, the researchers' skill and experience to detail were evident. The researchers' diligently to assemble the AC DC EIM Trainer carefully following the projected design and ensuring the precise integration of components. Once the electrical materials were put together, it was deployed for utilization in the implementation phase. The participants were oriented about their role in the study. They were allowed to check, operate and utilize the finished product. Participants were assisted when utilizing the AC DC EIM Trainer.



Figure 2 Showing the Finished AC DC EIM Trainer

The AC DC EIM Trainer could teach students and have the necessary expertise and abilities to install, repair, modify and retain residential, commercial and industrial electrical systems.

#### 4. Conclusions

It was developed successfully and effectively accomplished its goal of creating and enhancing the AC DC EIM Trainer using the ADDIE Model, has its technical characteristics; such as design, materials used, functionality, safety provision, performance efficiency, compatibility, usability, reliability, maintainability and portability; the AC DC EIM Trainer meets the approval of teacher's as evidenced by the result of their respective views and feedbacks; the AC DC EIM Trainer can be of great help in carrying out the teaching-learning process; The researcher believes that students will be interested in using this trainer. The ease and practicality of using the trainer may enable themselves to focus more in their studies. As a result, in the class will improve their performance and they will become more competent and skilled learners.

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